

**ABSTRACT OF THE DISCLOSURE**

Non-planar microfluidic devices and methods for transferring fluids between vessels and microfluidic devices are provided. The devices may be contoured to physically contact non-planar vessels, such as pipes, tubes, vials, or syringes to establish fluid communication between a vessel and a microfluidic device. Devices according to the invention may be constructed from flexible, rigid, or combinations of flexible and rigid materials. In certain embodiments, microfluidic devices are composed of sandwiched stencils, and self-adhesive tapes may be used for one or more layers. A microfluidic device may be removably attached to a vessel with a non-permanent adhesive or adhesive layer. Continuously wrapped microfluidic devices fashioned from a single layer, in addition to rewindable microfluidic devices constructed from multiple layers, are provided. A multi-plunger syringe permits a microfluidic device or other reservoir coupled to the vessel to be filled on the draw stroke of the syringe plunger.